December 9, 1998

Mr. R. P. Powers
Senior Vice President
Nuclear Generation Group
American Electric Power Company
500 Circle Drive
Buchanan, MI 49107-1395

SUBJECT: NRC INSPECTION REPORT NO. 50-315/98025(DRS)

Dear Mr. Powers:

On November 19, 1998, the NRC completed a special inspection at your D. C. Cook, Unit 1 reactor facility. The inspection was an examination of activities conducted under your license as they relate to your establishment of restart metric indicators to gage plant readiness for restart and to evaluate the progress in engineering resolution of ice condenser issues. Because the restart metrics factor into your assessment of plant readiness for restart, the NRC Manual Chapter 0350 Restart Panel will continue to monitor your progress in meeting established performance goals for these metrics. The enclosed report documents the results of the inspection.

The 22 restart metric indicators developed, demonstrated substantive progress toward achieving a data collection system to provide semi-quantitative measurement tools for assessing plant process and programmatic readiness for restart. The metric performance indicators with more potential value measured process product quality, such as 50.59 Quality, Calculation Quality and Root Cause Quality, or effectiveness, such as Corrective Actions Effectiveness.

A recent Performance Assurance department assessment identified weaknesses in the grading process used for safety evaluations, which indicated that more work is needed to effectively implement the restart metric indicator of 50.59 Quality. Additionally, the corrective action for this finding, to mentor engineering department personnel, may artificially influence the safety evaluation quality measurement for engineering.

Progress was observed in engineering resolution of issues pertaining to the ice condenser with the establishment of ice basket damage criteria and a systematic approach to incorporation of ice condenser information into the Updated Final Safety Analysis Report. However, resolution of previous NRC ice condenser findings had not progressed to a point that supported a final NRC review.

In accordance with 10 CFR 2.790 of the NRC'S "Rules of Practice," a copy of this letter, the enclosures, and your response to this letter, if you choose to provide one, will be placed in the NRC Public Document Room (PDR).

We will gladly discuss any questions you have concerning this inspection.

Sincerely,

Original /s/ John A. Grobe

John A. Grobe, Director
Division of Reactor Safety

Docket No.: 50-315
License No.: DPR-58

Enclosure: Inspection Report 50-315/98025(DRS)

cc w/encl: J. Sampson, Site Vice President
R. Eckstein, Chief Nuclear Engineer
D. Cooper, Plant Manager
R. Whale, Michigan Public Service Commission
Michigan Department of Environmental Quality
Emergency Management Division
MI Department of State Police
D. Lochbaum, Union of Concerned Scientists

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U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket No:	50-315
License No:	DPR-58
Report No:	50-315/98025(DRS)
Licensee:	Indiana Michigan Power Company
Facility:	Donald C. Cook Nuclear Generating Plant
Location:	1 Cook Place Bridgman, MI 49106
Dates:	November 12-19, 1998
Inspector:	M. Holmberg, Reactor Engineer
Approved by:	James Gavula, Chief, Engineering Specialists Branch 1 Division of Reactor Safety

EXECUTIVE SUMMARY

D. C. Cook, Unit 1
NRC Inspection Reports 50-315/98025

This was a special inspection to review the restart metrics developed to evaluate the plant readiness for restart and evaluate the progress in engineering resolution of ice condenser issues.

C The restart metric indicators developed by the licensee demonstrated substantive progress toward achieving a data collection system to provide semi-quantitative measurement tools for assessing plant process and programmatic readiness for restart. The metric performance indicators with more potential value measured process product quality, such as 50.59 Quality, Calculation Quality and Root Cause Quality, or effectiveness, such as Corrective Actions Effectiveness (Section 07.1).

C A recent Performance Assurance department audit identified weaknesses in the grading process used for 10 CFR 50.59 safety evaluations, which indicated that more work is needed to effectively implement the restart metric indicator for 50.59 Quality. Additionally, the corrective action for this finding, to mentor engineering department personnel, may artificially influence the safety evaluation quality measurement for engineering (Section 07.1).

C For the Self-Identification Ratio metric indicator, more information existed at the department level, which could be used to monitor or trend sustained department level performance and may provide more restart performance insight than the current aggregate station wide Self-Identification Ratio indicator (Section 07.1).

C Appropriate ice basket damage criteria had been implemented into the latest revisions of ice basket inspection and repair procedures (Section E8.1).

C Previous NRC inspections identified, that the Updated Final Safety Analysis Report Appendices contained outdated descriptions and design basis information related to the ice condenser. The licensee issued a procedure to provide a systematic approach to the incorporation of the required information into the actively maintained sections of the Updated Final Safety Analysis Report (Section E8.1).

C The licensee identified relatively small cracks in each of the containment spray system pump impellers caused by corrosion fatigue. The licensee corrective actions to weld repair or replace these impellers combined with planned periodic inspections were conservative and consistent with the metallurgical report conclusions and fracture mechanics analysis (Section E8.2).

Report Details

I. Plant Operations

O7 Quality Assurance in Operations

07.1 Restart Metrics Program

a. Inspection Scope (40500)

The inspector reviewed the “restart metrics” implemented by the licensee to gage plant program and process readiness for restart by evaluating performance indicators against established goals. This review focused on explanation and implementation status of the metric indicator, where the indicator was not self-defining.

b. Observations and Findings

A multi-discipline licensee group chaired by the plant manager was responsible for selecting the metrics used to assess plant readiness for restart. This group reviewed various performance monitoring programs at other utilities and consulted the Institute for Nuclear Power Organization and the Nuclear Energy Institute (NEI) reports on performance monitoring. The 22 restart metric indicators selected were grouped under six areas and represented a subset of all plant performance indicators currently in use by the plant. The list of restart metrics and performance goals current as of November 11, 1998, is included as Attachment 1 to this report.

The restart metrics developed include information on specific plant process products, which have been the subject of previous NRC inspection findings. The metric data collection processes reviewed were only recently implemented (typically without an issued administrative procedure to document the process) and undergoing frequent changes. Therefore, implementation effectiveness was not evaluated. The inspector evaluated the potential benefit (value) of the restart metric indicators chosen, by evaluating the indicator data potential to provide self-critical process feedback information for monitoring the associated program quality. On this basis, the restart metrics which measure process product quality, such as 50.59 Quality, Calculation Quality and Root Cause Quality, or effectiveness, such as Corrective Actions Effectiveness, were potentially the more valuable metric indicators. Conversely, the metric indicators which measure backlogs such as the Plant Status As-Built Drawings, Control Room Deficiencies, and Temporary Modifications did not readily lend to a self-critical feedback process and appeared to offer less value. Further, the number of items tracked in the backlog indicators appeared to demonstrate inefficiencies in past processes performance, and did not necessarily reflect on the associated program/process performance levels at, or following plant restart.

b.1 Organizational Readiness Metric

Five indicators (Management Leadership, Self-Identification Ratio, Root Cause Quality, Corrective Actions Effectiveness, Restart Item Work Completion) were chosen to define the organizational readiness metric. The frequency of monitoring against the established goal was typically monthly.

The Management Leadership metric indicator goal of implementing top level strategies was essentially completed. The top level strategies were composed of management effectiveness, design and licensing basis, training and qualification and continuous improvement. All of these strategies had been approved and with the exception of the design and licensing basis, each had been implemented. A recent performance assurance audit had identified deficiencies with the design and licensing basis strategy which included a lack of a sub-tier strategy to address prior problems with inadequate consideration for system/component failure modes. This strategy was undergoing an effectiveness review and had not been implemented.

The licensee used a contract company to establish the restart performance goal of 0.5 or greater for the Self-Identification Ratio indicator (defined as the number of condition reports identified by and attributed to a given department divided by the total number of condition reports attributed to a department). The 0.5 goal was for the aggregate performance of all departments and individual goals were set at the department level (e.g., 0.4 for engineering and 0.9 for chemistry). Although the licensee was meeting the overall goal, individual departments periodically fell below their established goals. The information which existed at the department level could be used to monitor or trend sustained department level performance, and could provide more restart performance insights than the current aggregate station wide Self-Identification Ratio indicator.

The Root Cause Quality metric indicator included a 100 percent review of root cause reports generated each month against desired attributes with assigned point values. A restart goal of 0.6 and improving was established for restart (1.0 would be a perfect score). This goal had been achieved for the current interval. A recent self-assessment completed by the corrective action department identified that the current checklist of 18 attributes used to support this grading system needed additional attributes to provide an adequate review scope. This review checklist was under revision to incorporate additional attributes.

The Corrective Action Effectiveness metric indicator, was still under development. However, the licensee staff indicated that prevention of recurrence of significant problems would be the criterion used to measure corrective action effectiveness. This measure provided a “look back” at previous root cause corrective actions (completed at least 3-6 months ago) to ensure corrective actions had been effective at preventing recurrence of the problematic condition. Therefore, the effectiveness of the current program changes and training to the root cause investigation process would not be determined until the first quarter of 1999. For root cause determinations completed in 1997, preliminary data indicated that over 50 percent of the root cause assessments were ineffective at preventing recurrence of the problematic condition.

b.2 Operations Readiness Metric

Four indicators (Operator Training, Operations Procedures For Startup and Power Ascension, Control Room Deficiencies and Surveillance Link Reviews) were chosen to define the operations readiness metric. The frequency of monitoring against the established goal was typically weekly.

The Operations Procedures For Unit 1 Startup and Power Ascension metric indicator tracked a population of operating procedure changes needed to support plant operation from shutdown through power operation. A group composed of a Senior Shift Manager and experienced Licensed Operators had identified 128 procedures which were reviewed and physically walked down to identify procedure deficiencies. As a result of these reviews, 40 procedures were scheduled (as of November) for revision prior to Unit 1 restart.

The Control Room Deficiencies metric indicator tracked action request tags in place on equipment control switches and meters in the control room. The control room action request tags included short term items such as, troubleshooting/repairing meters, troubleshooting equipment grounds, and longer term items such as, replacing outdated control room recorders. The goal for Unit 1 restart was less than 50 and the number as of November, was 115.

The Surveillance Link Reviews metric indicator tracked the number of procedure “links” to be verified for the surveillance test requirements identified in the Unit 1 Technical Specifications (TS). The 851 TS surveillance requirements were translated into 328 surveillance procedures with 1582 surveillance links identified between the TS and implementing procedures. A two party contractor review was in progress on these surveillance links to verify that TS surveillance requirements had been properly implemented into the surveillance procedures. All links were scheduled to be verified prior to Unit 1 restart.

b.3 Systems and Containment Readiness Metric

Four indicators (Restart Modification Complete, Systems Acceptance by Operations, Temporary Modifications, Corrective Maintenance) were chosen to define the systems and containment readiness metric. The frequency of monitoring against the established goal was typically weekly.

The Systems Accepted By Operations metric indicator tracked plant systems that had been turned over to and accepted by the operations department. Draft procedure U1F97A, “System Readiness Review,” described a system of reviews through system engineers, the System Engineering Review Board and the Restart Oversight Committee (level 1 systems only) prior to system “certification” (in the form of a System Readiness Review documentation package) and turnover to operations. As of November 11,1998, none of the 132 plant systems had been completed through the turnover process to operations.

The Corrective Maintenance Metric Indicator tracked the aggregate backlog of work (job order action items) identified within the work control process. This indicator was a roll-up of backlogs that included corrective maintenance for the ice condenser, outage review board and restart oversight committee approved corrective maintenance. For each of these subgroups, all corrective maintenance work was scheduled to be completed prior to Unit 1 restart. The remaining aggregate backlog of lower priority corrective maintenance work was scheduled to be completed such that 90 percent of the original backlog would be completed at restart (approximately 190 items were projected to remain outstanding).

b.4 Programmatic Readiness Metric

Four indicators (50.59 Quality, Updated Final Safety Analysis Report (UFSAR) Re-validation Project 50.59 Evaluations Required, Calculation Quality, Plant Status As-Built Drawings) were chosen to define the programmatic readiness metric. The frequency of monitoring against the established goal was typically weekly.

The 50.59 Quality metric indicator tracked the average score of safety evaluations and screenings reviewed and graded during the preceding month. The scope of this review included all safety evaluations generated and 25 percent of the screenings generated in the preceding month. The grades were based on a review of safety evaluations against an attribute list which measured the degree of compliance with governing procedure requirements (PMP 1040.SES.001 and NEI 96-07) with a grading scale (e.g., 4.0 = A, 3.0 = B, 2.0 = C). Any failures to meet 10 CFR 50.59 requirements to identify unreviewed safety questions or failures of screenings to identify the need for a full safety evaluation resulted in a failing grade of E. A recently issued Performance Assurance department audit PA 98-13/NSDRC # 254, documented weaknesses in the peer review grading system pertaining to insufficiently critical application of the grading criteria. Specifically, Performance Assurance department personnel had regraded 71 safety evaluations and screenings for the months of June and July and identified 15 percent as unsatisfactory (e.g., D or E grade). These unsatisfactory safety evaluations and screenings had been graded at C or above by the Engineering Nuclear Safety and Analysis division that performed the original grading. The one safety evaluation which received the E grade, pertained to operation of equipment with elevated lake water temperatures that potentially created a condition which increases the probability of failure (e.g., an unreviewed safety question). The licensee had an independent contractor assessment review this matter, which reportedly concluded the condition did not represent an unreviewed safety question. Many of the safety evaluations with lower grades were associated with engineering modifications. To resolve this issue, the licensee reportedly would implement a third party contractor monitoring/mentoring review in line with the modification review and approval process. However, the mentoring of engineering department personnel could artificially influence the safety evaluation quality measurement for engineering and undermine the 50.59 data collected on modification-related safety evaluations.

The UFSAR Revalidation Project 50.59 Evaluation Required metric indicator tracked the number of approved 50.59 evaluations associated with the UFSAR changes on the

21 risk significant systems selected for restart readiness reviews. This indicator was used to track the progress toward completing the UFSAR revalidation project.

The Calculation Quality metric indicator tracked the quality of calculations and revisions to calculations completed in the preceding month. The engineering effectiveness branch reviewed calculations for conformance with criterion established in the checklist of procedure 800000-LTG-5400-02, “Calculations,” Revision 1. The description of this grading process was described in Checklist ENE-03, “Engineering Effectiveness Evaluation Checklist for Calculations,” Revision 0. The failures of the calculation to comply with the checklist requirements were then categorized as administrative or technical and by severity. Five levels of technical severity ranging from negligible effect, to errors that may result in inoperability, were defined. Four levels of administrative severity ranging from minor editorial item (e.g., spelling typographical and grammar) to failure to follow governing calculation procedures were defined. A restart goal that 90 percent of the calculations would have only minor administrative or technical problems was established. The first two calculations reviewed in the preceding month received a 100 percent grade, exceeding the restart goal.

The Plant Status As-Built Drawings metric indicator tracked a subgroup of outstanding drawing revisions which had not been completed. A total backlog of approximately 6000 as-built drawing revisions remained outstanding. This backlog population was subdivided into three subgroups (operational drawings, engineering and design drawings, and plant status drawings). The operational drawings were utilized by operators to control the status of plant system. This group of drawings was reportedly updated as soon as the applicable modification was released to operations. The as-built engineering and design drawings represented the largest group of outstanding drawing revisions. The licensee staff reportedly intended to develop a work down schedule to address this backlog following restart of Unit 1. The number of plant status as-built drawings (predominantly electrical drawings designated by PS in the drawing number) which had not been updated to reflect as-built modifications was chosen as a restart indicator. The number of these type of drawings requiring revision was at 620 as of November and all were scheduled to be completed prior to Unit 1 restart.

b.5 Regulatory Readiness Metric

Three indicators (Licensing Submittals, Licensing Submittal Quality, Closeout Package Approvals) were chosen to define the regulatory readiness metric. The frequency of monitoring against the established goal was typically monthly.

The Licensing Submittal Quality metric indicator tracked an aggregate data point of graded regulatory submittals from the preceding month. The grading was performed in two party review process using licensee and contract personnel. The grading system evaluated licensing submittals against three attributes: completeness (4 points), timeliness (2 points), and format/clarity (4 points). The composite grade for the submittals based on a 10 point scale was tracked as the restart indicator. The target goal was 7.4 on this 10 point scale and the performance as of November was 6.8.

b.6 Communication Readiness Metric

Two indicators (Internal Communications, External Communications) were chosen to define the communications metric. The Internal Communications indicator was being monitored by periodic internal surveys and the expected goal was a rating of effective communication in all departments. A series of periodic public meetings with the local community (including community leaders) was under development to use as a means to meet the External Communications indicator.

c. Conclusions

The restart metric indicators developed by the licensee demonstrated substantive progress toward achieving a data collection system to provide semi-quantitative measurement tools for assessing plant process and programmatic readiness for restart. The inspector evaluated the potential benefit (value) of the restart metric indicators chosen, by evaluating the indicator data potential to provide self-critical process feedback information for monitoring the associated program quality. On this basis, the metric performance indicators with more potential value measured process product quality, such as 50.59 Quality, Calculation Quality and Root Cause Quality, or effectiveness, such as Corrective Actions Effectiveness.

A recent Performance Assurance department audit identified weaknesses in the grading process used for safety evaluations, which indicated that more work is needed to effectively implement the restart metric indicator for 50.59 Quality. Additionally, the corrective action for this finding, to mentor engineering department personnel, may artificially influence the safety evaluation quality measurement for engineering.

For the Self-Identification Ratio metric indicator, more information existed at the department level, which could be used to monitor or trend sustained department level performance and may provide more restart performance insight than the current aggregate station wide Self-Identification Ratio indicator.

III. Engineering

E8 Miscellaneous Engineering Issues

E8.1 Ice Condenser Engineering Issue Follow Up

a. Inspection Scope (92903)

The inspector reviewed the engineering department resolution and corrective action for previously identified ice condenser deficiencies.

b. Observations and Findings

Previous NRC and licensee inspections had identified numerous deficiencies within or associated with the ice condenser. To resolve the substantial number and types of issues, the licensee had grouped related deficiencies into 35 restart packages numbering 199 through 233. None of these packages had been completed through final internal review process and resolution of previous NRC ice condenser findings had not progressed to a point that supported a final NRC review.

b.1 Ice Basket Damage Criterion Established

In NRC inspection report 50-315/98005; 50-316/98005, numerous ice baskets with potentially detrimental damage were identified (escalated enforcement items 50-315/98005-(13,15,16)(DRS); 50-316/98005-(13,15,16)(DRS)). However, the licensee heretofore had not established criteria for detrimental ice basket damage. To resolve this issue, the licensee contracted Westinghouse Electric Company (WE) and Stevenson & Associates (S&A) to perform analyses of anticipated ice basket damage (dents, broken ligaments, screws and cruciform support deficiencies) and establish damage criteria. The licensee staff principally relied on these analysis results to develop detrimental and incidental (acceptable) damage criteria. Based on the damage criteria developed, the licensee estimated that up to 85 percent of the original Unit 1 ice baskets had required repairs or replacements. The Unit 2 ice basket repair work began near the completion of this inspection period and the licensee anticipated a similar population of ice baskets would need repairs to meet the damage criteria established.

The inspector reviewed the detrimental and incidental damage defined in engineering memorandum NESD-TDM-98-10-006, “Cook Nulcear Plant, Units 1 & 2 12-DCP-887, Ice Condenser Restoration Memo for Ice Basket Acceptable Incidental Damage,” Revision 3, and the supporting analysis results documented in WE letter, “Ice Condenser Ice Basket Acceptable Detrimental Damage,” dated March 17, 1998, and S&A calculation 98Q4014-C001, “D.C. Cook Ice Condenser Basket Acceptance Criteria,” Revision 1. The S&A calculation used bounding ice basket design structural loadings established in WCAP-8887, “Ice Basket Stress Analysis-D.C. Cook,” and verified the limit analysis calculation results using two nonlinear finite element models. The results demonstrated that the damaged ligament criteria incorporated into Revision 3 of NESD-TDM-98-10-006 was bounded under design basis accident loadings.

The licensee identified on September 3, 1998, that the damage criteria developed by WE and S&A had been improperly integrated into a definition of acceptable basket damage. The WE dent criteria had assumed no concurrent damage such as nearby ligament damage. On October 3, 1998, the licensee identified that the ice basket damage criteria had been incompletely translated into procedure 12CHP5021.MCD.004, “Removal and Replacement of Ice Condenser Ice Baskets.” Specifically, the restriction that no more than one dent per six foot basket section was omitted. The licensee had previously inspected baskets in bays 13 through 24 of Unit 1 using the incorrect/incomplete criteria. “Position Paper on Ice Condenser Detrimental Damage Resolution” Final Draft, dated November 17, 1998, documented that as a consequence of these errors ice baskets in bays 13-24 of Unit 1 had been reinspected (on a statistical sampling basis) to the meet the revised damage criteria. The inspector determined that, the licensee had adequately resolved these issues and had implemented conservative criteria into the current revisions of ice basket inspection and repair procedures. However, the issue of detrimental damage will remain open pending incorporation of detrimental damage criteria into ice basket surveillance procedure revisions (licensee restart package number 203).

b.2 Ice Condenser UFSAR Update Process Defined

In inspection report 50-315/98005; 50-316/98005, the NRC identified (escalated enforcement items 50-315/98005-(20-26)(DRS); 50-316/98005-(20-26)(DRS)) that the UFSAR had not been updated and maintained to accurately describe the ice condenser. To resolve this issue the licensee had issued procedure, RHP 7031.URP.006, “Ice Condenser UFSAR Rewrite,” Revision 0, to establish a process for removal of information that was not needed and to provide an adequate description of the ice condenser or presentation of its design basis. This procedure established a checklist with criteria to screen ice condenser description, design and analysis information contained in Appendix M and N of the UFSAR for incorporation into Chapter 5.3 of the UFSAR. A key parameter to successful implementation of this procedure, would be the consistent application of the definition and criteria for obsolete information which would be removed from the UFSAR. This procedure incorporated the applicable NRC requirements and latest industry guidance (NEI Procedure 98-03, “Guidelines for Updating Final Safety Analysis Report,” Final Draft Revision 0) to provide a systematic approach for bringing the ice condenser section of the UFSAR up to date. The final resolution of this issue will be examined following completion of the UFSAR section 5.3 update (licensee restart package number 233).

b.3 Justification For Past Operation With a Degraded Ice Condenser

In inspection report 50-315/98005; 50-316/98005, the NRC had identified (unresolved item 50-315/98005-31(DRS);50-316/98005-31(DRS)) that the degraded as found materiel condition of the ice condenser called into question, the ability of the ice condenser to perform its function and limit containment pressure increase to below design pressure following a design basis loss of coolant accident (LOCA). To resolve this issue the licensee contracted WE to perform a containment integrity analysis. By letter, “Containment Integrity Analysis- Justification for Past Operation, Revision 1," dated May 15, 1998, WE concluded that post LOCA containment pressure would have reached 11.91 psig and remained below the 12 psig design. However, in condition report number 98-2924, the licensee identified that other conditions impacted this evaluation such as increased reactor coolant system volume, debris in the spray header, and the containment spray heat exchanger installed backwards. The corrective action listed for this condition report was to identify all known conditions not accounted for and perform additional analysis. The plant staff reportedly were considering the use of probability risk assessment in evaluating the as found condition of the ice condenser and the potential risk to containment integrity. This issue will remain open pending review of the final containment integrity analysis and/or risk assessment.

c. Conclusions

Previous NRC inspections identified the lack of ice basket inspection related damage criteria. The licensee subsequently developed ice basket damage criteria. However, engineering staff had initially made errors in translating the analysis results into bounding ice basket damage criteria that consequently resulted in rework in the form of additional ice basket reinspections. The inspector determined that, the licensee had adequately resolved these issues and had implemented appropriate damage criteria into the latest revisions of ice basket inspection and repair procedures.

Previous NRC inspections identified the failure of the licensee to maintain the UFSAR sections up to date containing the description and design basis of the ice condenser. To resolve this issue, the licensee issued a procedure to provide a systematic approach to incorporation of the required information into the actively updated sections of the UFSAR.

To resolve an NRC concern pertaining to the as found operability of the ice condenser, the licensee performed a containment integrity analysis. However, the present analysis was not bounding and the licensee planned more analysis and/or risk assessment to resolve this concern.

E.8.2 Containment Spray Pump Impeller Cracking

a. Inspection Scope (92903)

The inspector reviewed licensee actions to resolve containment spray system (CTS) pump impeller cracking.

b. Observations and Findings

The licensee performed dye penetrant examination of Unit 1 CTS A351 CF8 cast stainless steel pump impellers as part of investigative corrective actions for a pump high vibration condition. In October of 1998, one or more crack indications were identified in each of the four containment spray pumps (at the vane to shroud junctions on the impeller) ranging in length up to 5/8 inches long. The licensee removed two sections from the 1 East CTS pump impeller for metallurgical analysis. Dominion Engineering Incorporated Report, R-4011-00-2, “Evaluation of Causes of Cook Containment Spray Pump Impeller Cracks,” Revision 0, and Southwest Research Institute Report, project No. 06-2321-107, “Investigation of pump impeller cracking at the Cook Nuclear Plant,” documented that the pump impeller cracking was transgranular with limited branching and concluded that the cracking was the result of corrosion fatigue. Based on tests of a spare unit at the manufactures’ plant, the licensee concluded that the high pump vibration levels were caused by pressure pulses associated with impeller to volute vane passing, which in turn was caused by the relative low flow rate in the small diameter test loop that is used for inservice tests. This pressure pulsing phenomena created multiple stress cycles per pump revolution and based on pump run times (from 267 to 728 hours) stress cycles to date, ranged to over one hundred million cumulative cycles on the pump impellers. The key contributors to this cracking were identified as the pressure pulsing fatigue cycle (the magnitude exacerbated by the low flow test conditions), the stress concentration at the vane tip to shroud juncture caused by sharp corner and porosity, and high residual mean stresses caused by local grinding.

The licensee had contracted Duke Engineering Services to perform a fracture mechanics evaluation STR-98-118, “Fracture Mechanics Evaluation of the D.C. Cook Containment Spray Pump Impeller,” Revision 0. This evaluation concluded that the existing cracks propagated slowly, were well below critical and allowable flaw sizes and adequate structural integrity remained for three additional years of operation with no repairs. The licensee conservatively chose to correct this condition for each CTS pump impeller by replacement or weld repair to remove identified crack indications. Additionally, the licensee staff reportedly were going to include reinspection of the CTS pump impellers at 50 hour cumulative run time intervals to identify cracking prior to reaching a flaw size that could jeopardize pump operation. The inspector considered the licensee corrective actions conservative and consistent with the metallurgical report conclusions and fracture mechanics analysis.

c. Conclusions

The licensee identified relatively small cracks in the each of the CTS pump impellers caused by corrosion fatigue. The inspector considered the licensee corrective actions to weld repair or replace these impellers combined with planned periodic inspection conservative and consistent with the metallurgical report conclusions and fracture mechanics analysis.

V. Management Meetings

X1 Exit Meeting Summary

The inspector presented the inspection results to members of licensee management at the conclusion of the inspection on November 19, 1998. The licensee acknowledged the inspection conclusions presented and did not identify any potential report material as proprietary.

PARTIAL LIST OF PERSONS CONTACTED

American Electric Power

J. Allard, Ice Condenser Production Manager
D. Cooper, Plant Manager
G. Hudson, Ice Condenser Project
E. Johnson, Ice Condenser Project
D. Kosloff, Licensing
L. Ormson, Engineering Programs
F. Pisarsky, Production Engineering
D. Powell, Plant Engineering
P. Russel, Ice Condenser Project Manager
J. Sampson, Site Vice President
P. Schoepf, Ice Condenser Project Engineer
T. Wagner, Restart Manager

US Nuclear Regulatory Commission

B. Bartlett, Senior Resident Inspector
B. Fuller, Resident Inspector
J. Maynen, Resident Inspector

INSPECTION PROCEDURES USED

IP 92903 Followup - Engineering
IP 40500 Effectiveness of Licensee Controls in Identifying, Resolving, and Preventing Problems

ITEMS OPENED, CLOSED, OR DISCUSSED

Opened

None

Closed

None

Discussed

50-315/98005-13(DRS) 50-316/98005-13(DRS)	EEI	Failure to identify/evaluate buckled webbing in lower section of ice baskets
50-315/98005-15(DRS) 50-316/98005-15(DRS)	EEI	Failure to promptly identify/evaluate missing ice basket sheet metal screws
50-315/98005-16(DRS) 50-316/98005-16(DRS)	EEI	Failure to prevent recurrence of loose U-bolt nuts
50-315/98005-20(DRS) 50-316/98005-20(DRS)	EEI	WCAP-11902 analysis not incorporated into the FSAR per 50.71e
50-315/98005-21(DRS) 50-316/98005-21(DRS)	EEI	As-built ice basket bottom assembly not incorporated into the FSAR per 50.71e
50-315/98005-22(DRS) 50-316/98005-22(DRS)	EEI	As-used ice form not incorporated into the FSAR description per 50.71e
50-316/98005-23(DRS)	EEI	Ice basket modified by 02-MM-032 not incorporated into the FSAR description per 50.71e
50-315/98005-24(DRS)	EEI	Ice baskets modified by 01-MM-048 not incorporated into the FSAR description per 50.71e
50-315/98005-25(DRS) 50-316/98005-25(DRS)	EEI	Westinghouse ice basket seismic load study, dated February 28, 1990 not incorporated into the FSAR per 50.71e
50-315/98005-26(DRS) 50-316/98005-26(DRS)	EEI	Revised replacement ice basket design not incorporated into the FSAR per 10 CFR 50.71e

LIST OF ACRONYMS USED

CTS -	Containment spray system
LOCA -	Loss of coolant accident
NEI -	Nuclear Energy Institute
S&A-	Stevenson and Associates Incorporated
TS-	Technical Specification
UFSAR-	Updated Final Safety Analysis Report
WE-	Westinghouse Electric Company

PARTIAL LIST OF DOCUMENTS REVIEWED

Draft procedure U1F97A, “System Readiness Review”

Checklist ENE-03, “Engineering Effectiveness Evaluation Checklist for Calculations,” Revision 0.

Performance Assurance Department Audit - PA 98-13/NSDRC#254, “Safety Reviews(10 CFR 50.59),” issued November 13, 1998.

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